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Endovascular Repair of Wide Neck AAA – Preliminary Report on Feasibility and Complications

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Aim: *to assess the feasibility of endovascular repair (EVR) of wide neck abdominal aortic aneurysms (AAA).*
Study design: *retrospective.*
Method: *a cohort of patient was identified who had an AAA neck diameter of 28 mm or more and underwent EVR. These patients undergo regular follow-up by 6 monthly CT scan of abdominal aorta. Two independent observers quantified the diameter of the suprarenal aorta, the top of the neck, the bottom of the neck, the length of the neck and the transverse diameter of the AAA.*
Results: *the study cohort comprised 16 patients. Bland Altman Analysis determined that the 95% interobserver limits of agreement were −4.7 to 3.3 mm. The mean preoperative diameter of the suprarenal aorta, the top of the neck and bottom of the neck all were 31 mm. On the follow-up CT scan on average after 12 months the suprarenal aorta measured 29 mm, the top of the neck 28 mm and the bottom of the neck 30 mm. There was a statistically significant decrease in the size of the top of the neck (*$p = 0.03$*).*
Conclusion: *this preliminary report suggests that the endovascular repair of AAA with a wide neck is feasible with available commercial devices. The necks do not appear to increase in size and there is no increased incidence of proximal endoleak.*

Key Words: Endovascular repair (EVR); Wide neck abdominal aortic aneurysm (wide neck AAA); Talent endograft.

Introduction

EVR of AAA which we have been carrying out since March 1994, is rapidly gaining acceptance as a minimally invasive alternative to conventional open repair.[1–4] Our early case selection was restricted by the size of the stent and balloons available to us and we only performed EVR on patients who had a neck diameter of 28 mm or less. More recently, commercial devices that allow patients with larger necks to be treated have become available. Publications on neck size have varied in their interpretation of the data some suggesting that a progressive increase occurs[5] and others finding no change.[6] A third view has been that the change in neck size relates to its original diameter-larger necks increase while the smaller necks do not. In order to investigate this we have followed changes in neck size in patients where commercial devices have been used in AAA with a neck size of >28 mm.

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Patients and Methods

All patients who had EVR of AAA using a Talent device since 1997 were identified by our vascular audit database. Only those patients where the aneurysm neck was >28 mm were included in the study. No grafts were excluded and all patients were treated on an intention to treat basis. A detailed proforma was completed on demography, presentation, CT findings, complications and follow-up. All patients undergo regular follow-up by 6 monthly CT of the abdominal aorta and all of the patients reported here had had a scan in the last 6 months (except one patient who lives in another country and his scan was performed at 4 months for practical reasons).

Protocol

The original scans of two of the patients were performed at different referring centres in the UK or overseas and these scans were not available for measurement. However, the original measurements, which were used to size the graft, were tracked and used in this study. Follow up measurements were made using spiral CT (Philips, Secura-spiral,

Netherlands). The machine scanned the abdomen from the diaphragm to common iliac arteries and slices were taken at intervals of 10 mm. Contrast (Visipaque(320)-100 ml) was then injected intravenously and 3 mm slices of the sac and graft taken. The window level was standardised at 100 and window width at 900. At these specifications there are no artefacts from the endograft struts. The aorta was measured at its maximum transverse diameter using a calliper at the suprarenal aorta, the top of the neck of the AAA and the bottom of the neck of the AAA. The length of the neck and the maximum transverse diameter of the sac were also calculated. The suprarenal aorta was measured from the slice immediately above the origin of the renal arteries and the diameter of the top of the neck was taken from first slice below the renal arteries. In one patient who had had a renal transplant, the renal arteries were not visible. In this case the measurements were taken at the level of the superior mesenteric artery. The bottom of the neck of the aneurysm was measured on the slice where the aneurysm wall was seen to be flaring away from the graft. The sac was measured at its maximum transverse diameter. Two independent observers measured the follow-up scans and were blinded to each other's results.

Statistical analysis

All the measurements were expressed as mean and 95% confidence intervals. For paired comparisons the Wilcoxon signed rank test was used. Follow up scans were measured twice with a time difference of 2–4 weeks by the inexperienced observer. Intraobserver error was calculated by the mean arithmetic difference between the two measurements of the same observer. Variability was calculated as twice the SD of the mean arithmetic difference according to Bland and Altman.[7]

Interobserver error was calculated by a similar technique by using measurements from two different observers. The two measurements from the inexperienced observer were averaged for the calculations. Only the experienced observer's measurements were used for the tables. The yearly rate of change in aortic diameter was calculated by the formula-Yearly change $= 12 * (\text{Follow-up scan} - \text{Original scan})/\text{months}$. A Wilcoxon signed rank test was applied to each measurement to evaluate the statistical significance of yearly change at each level.

Results

Sixteen patients with an infrarenal neck diameter of 28 mm or more were available to study. All were male with the mean age of 77 (67–83) years. The follow-up CT scan on these patients was done at a median of 12 (4–33 months).

The risk factors in this group revealed that 11 patients were hypertensive (69%), 7 had a history of previous myocardial infarction (44%) and 1 had a history of stroke (6%). None of the patients were diabetics. Only 3 patients were non-smokers (19%) and the remainder had stopped smoking. There was no family history of aortic aneurysm.

In 2 patients (13%) a Talent uni-iliac device was used while in the remaining patients a Talent bifurcated graft was deployed. The ipsilateral internal iliac artery was embolised preoperatively in those patients who had a uni-iliac graft inserted.

Complications

There were no deaths at thirty days. In one (6%) the graft could not be deployed at the first attempt for technical reasons and he had a successful EVAR done after 10 days. One patient (6%) had a stroke in the post operative period but recovered completely. One patient (6%) was readmitted after 3 weeks with an acutely ischaemic leg which was successfully salvaged. The late complications are shown in Table 1.

Measurements

The preoperative diameter, follow-up diameter and the p value for comparison between the two measurements are shown in Table 2. This table reveals that the supra renal aorta and the top of the neck decreased significantly in follow-up measurements ($p = 0.03$ and 0.03 respectively). The bottom of the neck decreased marginally but this was not statistically significant ($p = 0.5$). The length of the neck increased (mean of

Table 1. Late complications after endovascular repair of wide neck AAA.

No.	Complication	Action	Result
1	Persistent distal endoleak (type I)	Embolisation of right IIA/extension of graft	No further leak
2	Bilateral lumbar leak (type II)	No action	No increase in sac
3	Lumbar leak (type II) – 2 patients	Embolised	No further leak
4	Distal endoleak (type II)	Embolisation of IIA	No further leak
5	Slight perfusion of sac from lumbar vessels and IMA	No action	Sac not increased in size

IIA: Internal Iliac artery; IMA: Interior mesenteric artery.

Table 2. Result of pre-operative and follow up measurements and yearly rates of change of various aortic dimensions.

	Aortic diameter				Length of neck
	Supra renal	Top of neck	Bottom of neck	AAA size	
n	16	16	16	16	16
Preoperative	31 (29–32)	31 (30–32)	31 (30–31)	66 (60–72)	31 (27–35)
At follow-up	29 (27–32)	28 (26–31)	30 (28–32)	65 (58–72)	33 (29–37)
p	0.03	0.03	n.s. (0.5)	n.s. (0.5)	n.s. (0.07)
Yearly rate of change	−1.1 (−2.1–0)	−1.7 (−3.1–−0.3)	−0.3 (−1.6–1.1)	−0.05 (−2.6–2.5)	2.3 (−0.4–5.0)
p	0.03	0.01	n.s. (0.4)	n.s. (0.3)	0.02

Mean values in mm (95% CI), AAA – abdominal aortic aneurysm.

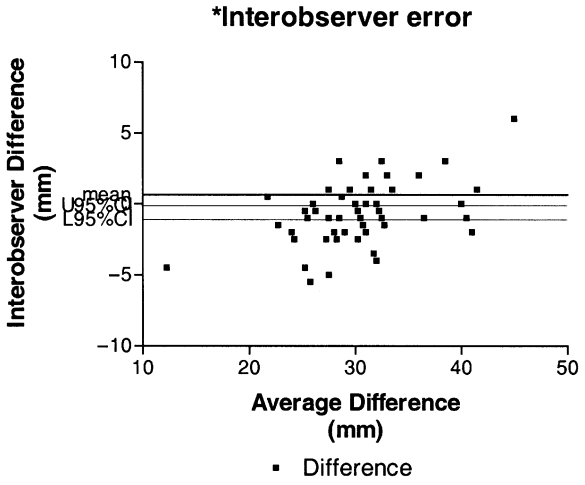

Fig. 1. Bland Altman plot – 95% limits of agreement in mm.

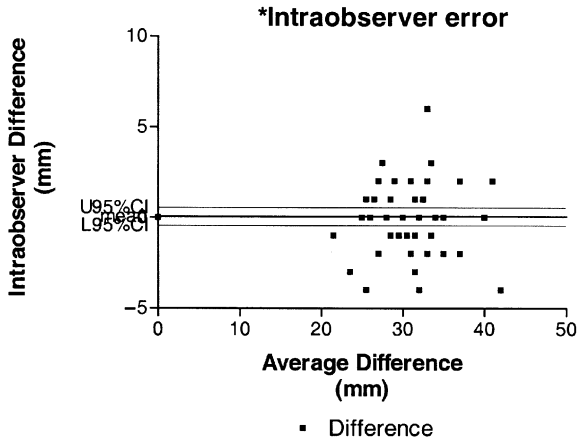

Fig. 2. Bland Altman plot – 95% limits of agreement in mm.

the differences −2.2 mm) but the increase was not significant. In the given follow-up period the sacs have also decreased in size but this decrease was not significant ($p = 0.5$). The average yearly rate of change in various measurements is shown in Table 2. The mean of interobserver and intraobserver error were calculated without the sac measurements as they may have better reproducibility. The mean interobserver error was −0.67 mm (95% CI: −1.2 to −0.2) indicating that the second observer measured the aorta as smaller than the first observer. The limits of agreement were −4.7–3.3 mm. The mean intraobserver error was 0 mm (95% CI: −0.5–0.4) and indicated that there was no bias in measurements from the second observer. The limits of agreement were −3.9–3.7 mm. The Bland Altman plots (inter and intra observer errors) are shown in Figures 1 and 2.

Discussion

EVR of AAA is now an established procedure but serious graft related complications have decreased the initial enthusiasm for this technique.[8,9] In our institute we have been performing EVR since 1994 and in the early period limited our cases to those with necks no greater than 28 mm in diameter because we were restricted by the availability of balloons and stents.

More recently with the development of larger commercial devices, we have been treating patients with necks of more than 28 mm. Regular CT scans are done as part of the follow-up in these cases although duplex is also routinely performed. The validity of duplex as a screening method for AAA has been argued by Lindholt.[10] The drawbacks of ultrasound for investigating the abdominal aorta are poor visibility of aorta that is often obscured by the pancreas and bowel gas. Because of this, variability of the measurements can be up to 8 mm.[11,12]

In this study the supra renal aorta decreased from a mean of 31 mm (95% CI: 29–32) in the preoperative period to 29 mm (95% CI: 27–32) in the follow-up period. This decrease was just significant ($p = 0.03$). Sonesson *et al*. found an increase in the size of the aorta at this level, which was statistically not significant.[13]

The top of the neck of the AAA in our study decreased from a preoperative diameter of 31 mm (95% CI: 30–32) to a follow-up diameter of 28 mm (95% CI: 26–31). This decrease was statistically significant ($p = 0.03$). This finding is in contrast to

previous studies, which showed that the infrarenal aortic neck increased in 33–55% of cases.[14] This finding is quite encouraging and we feel that wide necks may not be an anatomical factor for proximal endoleaks as suggested.[15] Prinssen reported that a continuous enlargement of approximately 1 mm/year at the level of the proximal endovascular anastomosis may occur.[16] At this rate, it might take up to 3 years to detect any abnormalities at the neck because we routinely oversize the graft by 2–3 mm. It has been suggested that oversizing of stents and excessive radial pressure may cause or accelerate dilatation of the aortic neck causing separation of the graft from the aortic wall and a proximal endoleak.[17] We have not seen this phenomenon in our patients.

As the aneurysm shrinks the length of the infrarenal neck appears to elongate on the CT scan. In this study the length of the neck increased from 31 mm (95% CI: 27–35) to 33 mm (95% CI: 29–37) in the follow-up period. Even though this increase is not significant ($p = 0.07$) it may indicate that the sac is shrinking around the graft and is a similar finding to that of Singh Ranger[18] who have shown that there was a shrinkage of sac volume at 6 months in patients where a Talent graft was used.

In our patients there was one (6%) type I endoleak and five (31%) type II endoleaks. The type I leak was distal and required coil embolisation of the internal iliac artery and an extension graft to stop it. No further leak has been noted in this patient.

The reported rate of type II endoleak varies from 6% to 31%. It has been reported that type II endoleaks do not result in an increase of the size of the aneurysm sac and the risk of rupture is small suggesting that these leaks may be managed conservatively.[19] In this study, 3 out of the 5 type II endoleaks were dealt with by coil embolisation of sac branches. The sac size in our series has decreased from 66 mm (95% CI: 60–72) to 65 mm (95% CI: 58–72), which was not significant ($p = 0.54$). According to Darling *et al*.[20] the time taken to increase the size of the sac by collateral circulation is about four years so an increase could still occur in our patients. In addition the sac can increase in size due to persistent endotension even when there is no evidence of endoleak.[21] Therefore, as suggested by Matsumura[22] a close follow-up remains mandatory but our preliminary findings are encouraging.

Conclusion

This preliminary report suggests that the endovascular repair of AAA with a wide neck is feasible with the recently available commercial devices. This has not increased the risk of proximal endoleaks in our patients and the complications noted were similar to those noted previously in those patients with narrow necks. A long term follow-up will be required but the preliminary findings appear encouraging.

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